

***Varicellaria emeiensis* sp. nov. and a review of the genus in China**

JIANHUA ZHOU & QIANG REN*

College of Life Sciences, Shandong Normal University,
Jinan 250014, China

* CORRESPONDENCE TO: rendaqlang@hotmail.com

ABSTRACT—A new species, *Varicellaria emeiensis*, is described from Sichuan Province, southwest China. It is characterized by its lecanorate apothecia with heavily white-pruinose discs, 8-spored ascus, and the presence of lecanoric acid. Additional material is reported for four *Varicellaria* species previously recorded from China, and a key is provided to the five species known from China.

KEY WORDS—*Ochrolechiaceae*, *Pertusariales*, lichens, taxonomy

Introduction

The circumscription of *Varicellaria* Nyl. was enlarged by Schmitt & al. (2012), a genus now characterized by its disciform ascomata, non-amyloid hymenial gel, strongly amyloid asci, 0–1-septate ascospores with thick one-layered walls, and the presence of lecanoric acid. All the described species contain lecanoric acid, and may also contain lichexanthone or variolaric acid (Schmitt & al. 2012).

In China, *Varicellaria rhodocarpa* was first reported by Ren & al. (2003), and *V. lactea* by Ren & Li (2013), and Zhao & al. (2004) and Ren (2011) reported two other *Varicellaria* species as *Pertusaria*. During the revision of *Varicellaria* in China, some specimens identified as *Pertusaria carneopallida* by Ren (2011) and *Ochrolechia pallidescens* by Ren & Jia (2011) have been reexamined, revealing a new species, described here as *Varicellaria emeiensis*.

Material & methods

The holotype specimen is conserved in the lichen herbarium of Herbarium Mycologicum, Chinese Academy of Sciences, Beijing, China (HMAS-L); other examined specimens are preserved in CANL, HMAS-L, KUN, SDNU, and TNS-L. The morphology of all specimens was studied using an Olympus SZX16 stereomicroscope and an Olympus BX61 compound microscope and photographed using an attached Olympus DP72 digital camera. The secondary metabolites were identified by spot tests and thin-layer chromatography (TLC) using solvents A, B, and C (Elix 2014).

Taxonomy

Varicellaria emeiensis Q. Ren, sp. nov.

PL. 1

FUNGAL NAME FN 570520

Differs from *Varicellaria velata* by its 8-spored asci and much smaller ascospores and from *Pertusaria carneopallida* by the presence of lecanoric acid.

TYPE: China: Sichuan, Mt. Emei, alt. 3160 m, on *Abies* sp., 17 Aug. 1963, Zhao & Xu 07669 (Holotype, HMAS-L 0019875).

ETYMOLOGY: The specific epithet *emeiensis* refers to the locality of the type collection, Mt. Emei, located in Sichuan Province, southwest China.

Thallus grey, thin, prothallus absent, not zoned, surface slightly tuberculate, shiny or dull; soredia and isidia absent. Apothecia lecanorate, round to irregular, numerous, well dispersed, concolourous with thallus, mostly single, rarely 2–3 fused, 0.7–0.8(–1) mm diam.; disc pale red-brown, plane, covered with heavily white pruina; epithecium hyaline to brownish, K–; hypothecium hyaline; ascospores 8 per ascus, uniseriate or irregularly biseriate, round or ellipsoidal to broad-ellipsoidal, 20–27.5 × 12–20 µm; ascospore wall smooth, 2–3 µm thick, and end wall not trimmed.

CHEMISTRY—cortex K–, C–, KC–, Pd–, UV–; medulla K–, C+ red, KC+ red, Pd–. Lecanoric acid (TLC).

ADDITIONAL SPECIMENS EXAMINED: CHINA: SICHUAN, Mt. Emei, Qianfo Ding, 3100 m, on bark, 14 Nov. 1964, Wei 2253 (HMAS-L: Ren 2011 (as *Pertusaria carneopallida*); Jinding, 3160 m, on *Abies* sp., 17 Aug. 1963, Zhao & Xu 7775, 7968, 7875, 7971 (HMAS-L); on *Abies* sp., 19 Apr. 1994, Wei s. n. (HMAS-L; Ren & Jia 2011 (as *Ochrolechia pallescens*); 3050 m, on bark, 27 Sept. 2001, Jia S243 (HMAS-L); Xixiang Chi, 2200 m, on bark of broadleaf tree, 14 Aug. 1963, Zhao & Xu 7367 (HMAS-L); Taizi Ping, 2800 m, on rotten wood, 18 Aug. 1963, Zhao & Xu 8190 (HMAS-L).

COMMENTS—*Varicellaria emeiensis*, which is characterized by its lecanorate apothecia with heavily white-pruinose discs, 8-spored ascus, and the presence of lecanoric acid, was erroneously reported from Mt. Emei in China as *Pertusaria carneopallida* (Nyl.) Anzi ex Nyl. by Ren (2011) and *Ochrolechia pallescens*

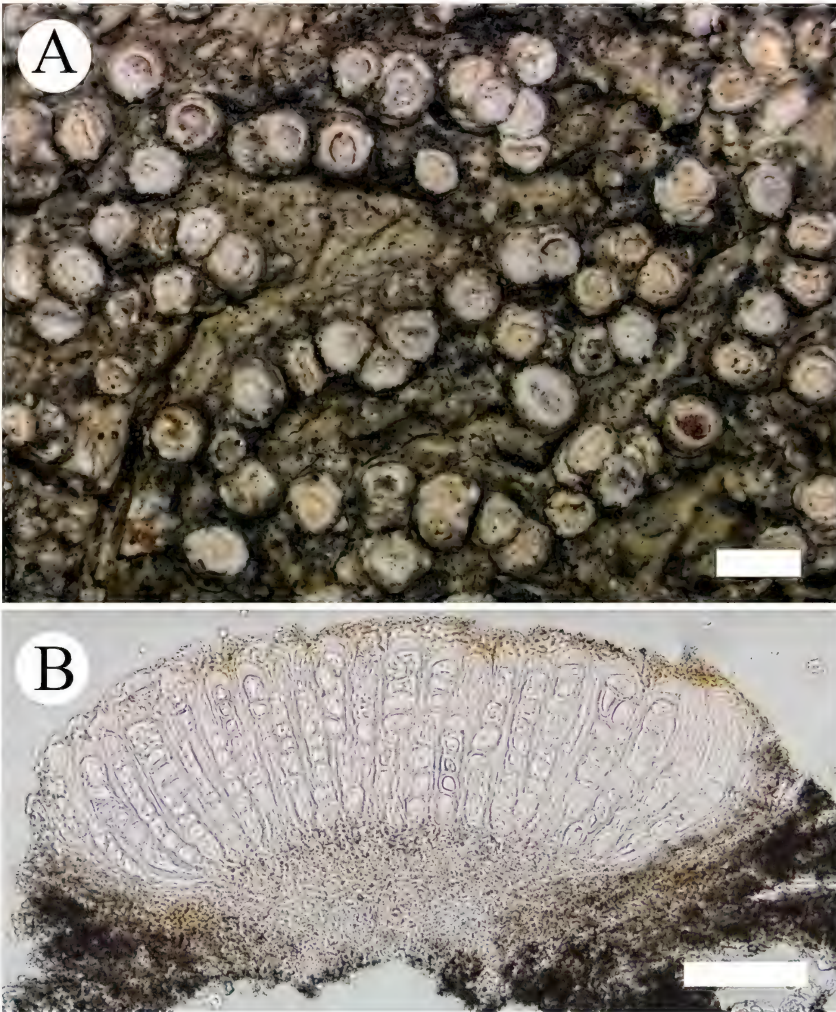


PLATE 1. *Varicellaria emeiensis* (holotype, HMAS-L 0019875). A. Thallus showing disciform apothecia with heavy white pruina and red-brown disc; B. Apothecium cross-section showing 8-spored ascus. Scale bars: A = 1 mm, B = 100 μ m.

(L.) A. Massal. by Ren & Jia (2011). *Varicellaria emeiensis* morphologically resembles *V. velata* and *Pertusaria carneopallida*; *V. velata* is distinguished by producing one much larger (160–250 μ m long) ascospore per ascus, while *P. carneopallida* contains gyrophoric acid (Dibben 1980).

Varicellaria hemisphaerica (Flörke) I. Schmitt & Lumbsch,
Myckeys 4: 29 (2012).

Thallus bluish-gray; prothallus white, distinct, zoned; soralia white, convex, 0.3–1.5 mm in diam., often confluent; soredia granular; on well-lit tree bark. Apothecia not seen.

CHEMISTRY—cortex K–, C–, KC–, Pd–, UV–; medulla and soralia K–, C+ red, KC+ red, Pd–. Lecanoric acid (TLC).

SELECTED SPECIMENS EXAMINED: CHINA: FUJIAN, Mt. Wuyi, Zhumu Gang, 1480 m, on bark, 4 Oct. 1981, Qian 03084 (HMAS-L). SICHUAN, Mt. Emei, Jinding, 3160 m, on bark, 17 Aug. 1963, Zhao & Xu 7905 (HMAS-L). XIZANG, Chayu Co., Chawalong Town, 3800 m, on bark, 27 Sep. 1982, Su 5020 (HMAS-L). YUNNAN, Zhongdian Co. [now Xianggelila Co.], Bigu Forest Farm, 2300 m, on *Picea* sp., 13 Aug. 1981, Wang & al. 5345 (HMAS-L).

COMMENTS—*Varicellaria hemisphaerica*, growing on rough, well-lit, lower part of trunk, very rarely on rock, is characterized by its pale bluish-grey tinged thallus; conspicuous, paler or concolorous, and convex soralia; and the presence of lecanoric acid (Chambers & al. 2009, as *Pertusaria hemisphaerica*). It might be confused with *Ochrolechia androgyna* (Hoffm.) Arnold and *V. lactea*. *Ochrolechia androgyna* is distinguished by a grey-white thallus containing gyrophoric and fatty acids and the absence of a prothallus (Ren 2017). When growing on rock, *V. hemisphaerica* resembles *V. lactea*, which differs in its white, regularly rimose-cracked thallus; only slightly convex, pure white, discrete soralia; and growth on well-lit, dry siliceous rock (Ren & Li 2013).

This species has been reported from Fujian, Xizang, and Sichuan Provinces as *Pertusaria hemisphaerica* (Ren & Zhao 2004, Zhao & al. 2004, Ren 2011). Specimens erroneously reported as (1) *P. hemisphaerica* from Yunnan Province by Zhao & al. (2004), Ren & Zhao (2004), and Ren (2011) should be revised as *Ochrolechia mahuensis* Räsänen (Ren 2017) and (2) *P. hemisphaerica* from Gansu Province by Yang & al. (2008) contain picrolichenic acid and are assigned to *Lepra amara* (Ach.) Hafellner.

Varicellaria lactea (L.) I. Schmitt & Lumbsch, Myckeys 4: 31 (2012).

Thallus white to grey-white, thick, smooth, dull, regularly rimose-areolate; prothallus distinct, often zoned; soralia white, scattered, rounded, 0.5–1.5 mm in diam.; often on dry, siliceous rock. Apothecia not seen.

CHEMISTRY—cortex K–, C+ yellowish, KC+ red, Pd–, UV–; medulla and soralia K–, C+ red, KC+ red, Pd–. Lecanoric and variolaric acids (TLC).

SELECTED SPECIMENS EXAMINED: CHINA: HEILONGJIANG, Tahe Co., Baikal Shan, 800 m, on rock, 25 Aug. 2011, Cheng 20125512 (SDNU). JILIN, Mt. Changbai, Changbai Waterfall, 1950 m, on rock, 20 Jul. 2014, Hu 20141175 (SDNU). NEI MENGKU, Aershan

City, Jiguan Shan, 1400 m, on rock, 29 Aug. 2011, Jiang 20124938, 20124759 (SDNU).
SHAANXI, Mt. Taibai, Paomaliang, 3600 m, on granite, 30 Dec. 1963, Ma & Zong 256
(HMAS-L). YUNNAN, Jianchuan Co., Shibao Shan, 2640 m, on siliceous rock, 17 Aug.
2011, Ren 1745 (SDNU).

COMMENTS—*Varicellaria lactea* is characterized by its white-grey thallus with a regularly rimose-areolate surface; round, white soralia; the presence of lecanoric and variolaric acids; and the substrate of dry, siliceous or slightly calcareous rock. Apothecia were not seen in Chinese material (Ren & Li 2013). This species might be confused with *V. hemisphaerica*, which is distinguished by a pale blue-grey thallus with paler convex soralia. *Lepra excludens* (Nyl.) Hafellner also occurs on rocks but produces a C– medulla and soralia.

Varicellaria rhodocarpa (Körb.) Th. Fr., Lich. Scand. 1: 322 (1871).

Thallus thin, smooth, shiny, epruinose, whitish to yellowish, isidia and soredia absent. Fertile verrucae scattered, 0.5–1.2 mm in diam. Apothecia 1 or 2–3 per verruca, with pinkish or yellowish disc; asci 1-spored; ascospores hyaline, 1-septate, $227\text{--}270 \times 55\text{--}110\ \mu\text{m}$; ascospore walls $10\text{--}27\ \mu\text{m}$ thick.

CHEMISTRY—cortex K–, C–, KC–, Pd–, UV– or + orange; medulla K–, C+ red, KC+ red, Pd–. Lecanoric acid, $\pm$ lichexanthone (TLC).

SELECTED SPECIMENS EXAMINED: CHINA: GANSU, Wenxian Co., Qiujiaba, 2550 m, on bark, 3 Aug. 2007, Yang 20070152 (SDNU). SHAANXI, Ningshan Co., Pingheliang, 2200 m, on bark, 28 Jul. 2005, Zhao 965 (HMAS-L). XIZANG, Chayu Co., Zhula Pass between Azha and Lagu Yangge, 4150 m, on moss, 12 Aug. 1973, Zhang s.n. (HMAS-L). YUNNAN, Xianggelila Co., Shika Snow Mountain, 4100 m, on bark, 2 Nov. 2008, Sun 20081976 (SDNU).

COMMENTS—*Varicellaria rhodocarpa* is an arctic-alpine species growing on bark, rock, or mosses that has been reported from Europe, North America, and Japan (Oshio 1968). This species, characterized by its large, 2-celled ascospores ($227\text{--}270\ \mu\text{m}$ long), was first reported in China by Ren & al. (2003). The specimens examined indicate two chemotypes: the common chemotype of the species containing lecanoric acid only, and chemotype 2 with additional lichexanthone. *Varicellaria rhodocarpa* resembles a poorly developed *V. velata*, which is otherwise distinguished by a 1-celled ascospore.

Varicellaria velata (Turner) I. Schmitt & Lumbsch, Mycokeys 4: 31 (2012).

Thallus grey-white, smooth to wrinkled and rimose-cracked, shiny or dull; prothallus distinct, zoned; isidia and soredia absent. Apothecia disk-like, abundant, well-scattered, rarely confluent, 0.2–1.0 mm in diam., with pinkish or yellowish disc covered with white pruina; asci 1-spored; ascospores hyaline, large, $160\text{--}250 \times 60\text{--}80\ \mu\text{m}$; ascospore walls $10\text{--}31\ \mu\text{m}$.

CHEMISTRY—cortex K–, C–, KC–, Pd–, UV– or + orange; medulla K–, C+ red, KC+ red, Pd–. Lecanoric acid, ± lichexanthone (TLC).

SELECTED SPECIMENS EXAMINED: CHINA: ANHUI, Huoshan Co., Baimajian, 1200 m, on bark, 9 Jun. 2011, Dong 20113177 (SDNU). FUJIAN, Wuyishan City, Tongmu Village, 1200 m, on bark, 26 Oct. 2010, Li 20105773 (SDNU). GANSU, Zhouqu Co., Huacaopo, 3300 m, on *Abies* sp., 29 Jul. 2006, Yang & Shi 060935 (SDNU). GUANGXI, Tianlin Co., Cenwanglao Shan, 1900 m, on bark, 23 Mar. 2011, Li 20110677 (SDNU). GUIZHOU, Mt. Fanjing, near Chengen Temple, 27°54'N 108°41'E, 2120 m, on bark of broadleaf tree, 8 Oct. 2012, Ren 2165 (SDNU). HAINAN, Wuzhishan City, at the foot of Wuzhi Shan, on bark, 20 Apr. 1993, Jiang & Guo H-1030-1 (HMAS-L). HEILONGJIANG, Yichun City, Liangshui National Nature Reserve, 48°04'N 129°09'E, 305 m, on bark, 28 Aug. 2014, Wei & al. HLJ201400944 (HMAS-L). HUBEI, Shennongjia, 2830 m, on bark, 9 Jul. 1984, Wu 8400528 (HMAS-L). HUNAN, Sangzhi Co., Bagong Shan, 1400 m, on *Castanea mollissima*, 24 Nov. 2010, Li 20106288 (SDNU). JIANGXI, Mt. Lushan, Xiao Tianchi, on bark, 15 Jun. 1955, Wu 550035 (HMAS-L). JILIN, Helong City, Zengfeng Shan, 1600 m, on bark, 19 Aug. 2011, Cheng 20120288 (SDNU). LIAONING, Kuandian Co., Baishilazi Nature Reserve, 40°52'N 124°47'E, 450 m, on rock, 8 Sep. 1989, Chen 7186 (CANL). SHAANXI, Mt. Taibai, on the roadside between Dadian and Doumu Temple, 2650 m, on siliceous rock, 3 Aug. 2005, Ren 05-224 (SDNU). SICHUAN, Jiuzhaigou Co., the Long Lake, 33°02'27"N 103°56'06"E, 3060 m, on *Picea* sp., 12 Aug. 2016, Ren 4312 (SDNU). TAIWAN, Taizhong Co., Rengechi, 31 Dec. 1925, Asahina 263 (TNS-L). XIZANG, Chayu Co., the north slope of Songta Snow Mountain, 3200 m, on bark, 26 Jun. 1982, Su 1778 (HMAS-L); Bomi Co., near Baka Village, 30°03'32"N 95°11'50"E, 2671 m, on rotten wood, 7 Sep. 2014, Wei & Wang XZ20140339 (HMAS-L). YUNNAN, Lijiang City, Lijiang Alpine Botanical Garden, 3210 m, on *Quercus pannosa*, 16 Aug. 2011, Ren 1553, 1556 (SDNU); Weixi Co., Laowu Houshan, 2600 m, on bark, 21 May 1982, Wang 82-344 (KUN); Dali City, Mt. Cangshan, 3000 m, on branch, 14 Aug. 2011, Ren 1385 (SDNU); Xiangelila Co, Tiansheng Bridge, 3500 m, on bark, 3 Nov. 2008, Sun 20081262 (SDNU). ZHEJIANG, Tiantai Shan, near the peak of Huading Shan, 910 m, on bark, 23 Aug. 1986, Qian 04336 (HMAS-L).

COMMENTS—*Varicellaria velata*, a cosmopolitan species growing on various substrates, is widespread in China (Zhao & al. 2004, Ren 2011, as *Pertusaria velata*). This species is characterized by its disciform ascomata with pruinose to sorediate discs, 1-spored asci, and the presence of lecanoric acid in all specimens and additional lichexanthone in some specimens. The specimens examined indicate two chemotypes: the common chemotype containing lecanoric acid only and chemotype 2 with additional lichexanthone. *Varicellaria velata* resembles *Ochrolechia pallescens*, which is distinguished by 8-spored asci, much smaller (52–72 × 26–34 µm) ascospores, and the presence of gyrophoric, lecanoric, variolaric, and alecotoronic acids (Ren 2017).

Key to the species of *Varicellaria* known in China

- 1a. Ascospores 2-celled. *V. rhodocarpa*
- 1b. Ascospores 1-celled or absent 2

2a. Thallus esorediate	3
2b. Thallus sorediate	4
3a. Asci 1-spored; lecanoric acid (sometimes with additional lichexanthone). . <i>V. velata</i>	
3b. Asci 8-spored; lecanoric acid. <i>V. emeiensis</i>	
4a. Thallus corticolous (rarely saxicolous); lecanoric acid. <i>V. hemisphaerica</i>	
4b. Thallus saxicolous; lecanoric and variolaric acids	<i>V. lactea</i>

Acknowledgements

This project was supported by the National Natural Science Foundation of China (31370066) and the Excellent Young Scholars Research Fund of Shandong Normal University. CANL, HMAS-L, KUN and TNS-L are thanked for the loan of the specimens. We are very grateful to Drs. André Aptroot (ABL Herbarium, Soest, The Netherlands) and Shouyu Guo (Institute of Microbiology, CAS, China) for reviewing the manuscript.

Literature cited

- Chambers SP, Gilbert OL, James PW, Aptroot A, Purvis OW. 2009. *Pertusaria* DC. 673–687, in: CW Smith & al. (eds). The lichens of Great Britain and Ireland. British Lichen Society, London.
- Dibben MJ. 1980. The chemosystematics of the lichen genus *Pertusaria* in North America north of Mexico. Publications in Biology and Geology, Milwaukee Public Museum 5. 162 p.
- Elix JA. 2014. A catalogue of standardized thin-layer chromatographic data and biosynthetic relationships for lichen substances, 3rd edition. Published by the author, Canberra.
- Oshio M. 1968. Taxonomical studies on the family *Pertusariaceae* of Japan. Journal of Science of the Hiroshima University, series B, Div. 2 (Botany), 12: 81–163.
- Ren Q. 2011. Taxonomic study of *Pertusaria* from China. 131–156, in: HJ Liu & al. (eds). The Present Status and Potentialities of Lichenology in China. Science Press, Beijing.
- Ren Q. 2017. A revision of the lichen genus *Ochrolechia* in China. Lichenologist 49: 67–84. <https://doi.org/10.1017/S0024282916000529>
- Ren Q, Jia ZF. 2011. Taxonomic study of *Ochrolechia* (*Ochrolechiaceae*) from China. 169–181, in: HJ Liu & al. (eds). The Present Status and Potentialities of the Lichenology in China. Science Press, Beijing.
- Ren Q, Li SX. 2013. New records of crustose lichens from China–1. Mycotaxon 125: 65–67. <https://doi.org/10.5248/125.65>
- Ren Q, Zhao ZT. 2004. Two new records of the lichen genus *Pertusaria* from China. Guihaia 24: 329–331.
- Ren Q, Zhao ZT, Wei JC. 2003. A lichen genus *Varicellaria* Nyl. from China. Mycosystema 22: 216–218.
- Schmitt I, Otte J, Parnmen S, Sadowska-Deś AD, Lücking R, Lumbsch HT. 2012. A new circumscription of the genus *Varicellaria* (*Pertusariales*, *Ascomycota*). MycoKeys 4: 23–36. <https://doi.org/10.3897/mycokeys.4.3545>
- Yang F, Ren Q, Shi XL, Zhang Q, Zhao ZT. 2008. The lichen genus *Pertusaria* from Bailong River Valley of Gansu, China. Mycosystema 27: 622–626.
- Zhao ZT, Ren Q, Aptroot A. 2004. An annotated key to the lichen genus *Pertusaria* in China. Bryologist 107: 531–541. [https://doi.org/10.1639/0007-2745\(2004\)107\[531:AAKTTL\]2.0.CO;2](https://doi.org/10.1639/0007-2745(2004)107[531:AAKTTL]2.0.CO;2)